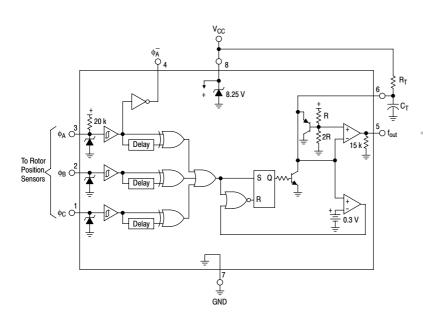
Closed Loop Brushless Motor Adapter

The MC33039 is a high performance closed-loop speed control adapter specifically designed for use in brushless DC motor control systems. Implementation will allow precise speed regulation without the need for a magnetic or optical tachometer. This device contains three input buffers each with hysteresis for noise immunity, three digital edge detectors, a programmable monostable, and an internal shunt regulator. Also included is an inverter output for use in systems that require conversion of sensor phasing. Although this device is primarily intended for use with the MC33035 brushless motor controller, it can be used cost effectively in many other closed-loop speed control applications.

Features

- Digital Detection of Each Input Transition for Improved Low Speed Motor Operation
- TTL Compatible Inputs With Hysteresis
- Operation Down to 5.5 V for Direct Powering from MC33035
 Reference
- Internal Shunt Regulator Allows Operation from a Non–Regulated Voltage Source
- Inverter Output for Easy Conversion between 60°/300° and 120°/240° Sensor Phasing Conventions
- Pb-Free Packages are Available



Representative Block Diagram



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PDIP-8 N SUFFIX CASE 626



MARKING



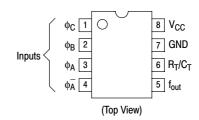
SOIC-8 D SUFFIX CASE 751



A = Assembly Location

WL, L = Wafer Lot YY, Y = Year WW, W = Work Week G or ■ = Pb-Free Package

PIN CONNECTIONS



ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 6 of this data sheet.

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
V _{CC} Zener Current	I _{Z(V_{CC})}	30	mA
Logic Input Current (Pins 1, 2, 3)	I _{IH}	5.0	mA
Output Current (Pins 4, 5), Sink or Source	I _{DRV}	20	mA
Power Dissipation and Thermal Characteristics Maximum Power Dissipation @ $T_A = +85^{\circ}C$ Thermal Resistance, Junction-to-Air	P _D R _{θJA}	650 100	mW °C/W
Operating Junction Temperature	T _J	+150	°C
Operating Ambient Temperature Range MC33039 NCV33039	T _A	-40 to +85 -40 to +125	°C
Storage Temperature Range	T _{stg}	-65 to +150	°C

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

ELECTRICAL CHARACTERISTICS ($V_{CC} = 6.25 \text{ V}$, $R_T = 10 \text{ k}$, $C_T = 22 \text{ nF}$, $T_A = 25^{\circ}\text{C}$, unless otherwise noted)

Characteristic	Symbol	Min	Тур	Max	Unit
LOGIC INPUTS		•			
Input Threshold Voltage					V
High State	V _{IH}	2.4	2.1	_	
Low State	V_{IL}	_	1.4	1.0	
Hysteresis	V_{H}	0.4	0.7	0.9	
Input Current	I _{IH}				μΑ
High State ($V_{IH} = 5.0 \text{ V}$)					
ФΑ		- 40	- 60	- 80	
ϕ_{B},ϕ_{C}		_	- 0.3	- 5.0	
Low State $(V_{IL} = 0 V)$	Iլլ				
ФΑ		- 190	- 300	- 380	
фв, фс		_	- 0.3	- 5.0	
MONOSTABLE AND OUTPUT SECTIONS					
Output Voltage	V _{OH}				V
High State					
f_{out} ($I_{source} = 5.0 \text{ mA}$)		3.60	3.95	4.20	
$\phi_{\overline{A}}^{-}$ (I _{source} = 2.0 mA)		4.20	4.75	_	
Low State	V _{OL}		0.05	0.50	
$f_{out} (I_{sink} = 10 \text{ mA})$		_	0.25	0.50	
ϕ_A^- (I _{sink} = 10 mA)		_	0.25	0.50	
Capacitor C _T Discharge Current	I _{dischg}	20	35	60	mA
Output Pulse Width (Pin 5)	t _{PW}	205	225	245	μs
POWER SUPPLY SECTION					
Power Supply Operating Voltage Range	V _{CC}	5.5	-	V_Z	V
MC33039 ($T_A = -40^{\circ} \text{ to } +85^{\circ}\text{C}$)					
NCV33039 ($T_A = -40^{\circ} \text{ to } +125^{\circ}\text{C}$)					
Power Supply Current	I _{CC}	1.8	3.9	5.0	mA
Zener Voltage (I _Z = 10 mA)	V _Z	7.5	8.25	9.0	٧
Zener Dynamic Impedance ($\Delta I_Z = 10 \text{ mA}$ to 20 mA, f $\leq 1.0 \text{ kHz}$)	Z _{ka}	_	2.0	5.0	Ω

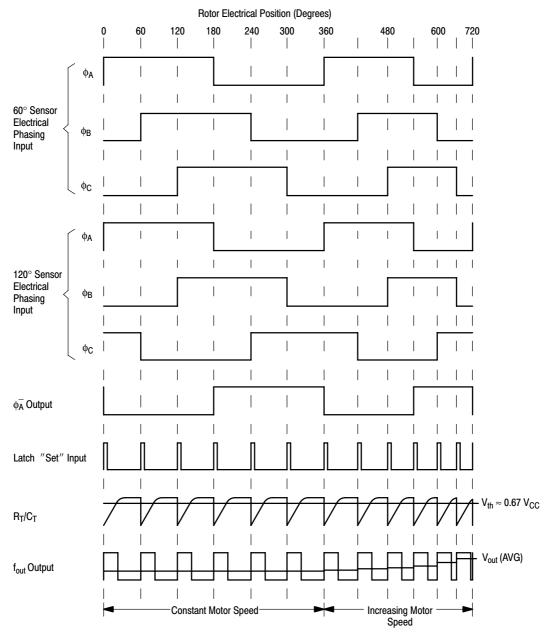


Figure 1. Typical Three Phase, Six Step Motor Application

OPERATING DESCRIPTION

The MC33039 provides an economical method of implementing closed—loop speed control of brushless DC motors by eliminating the need for a magnetic or optical tachometer. Shown in the timing diagram of Figure 1, the three inputs (Pins 1, 2, 3) monitor the brushless motor rotor position sensors. Each sensor signal transition is digitally detected, OR'ed at the Latch 'Set' Input, and causes C_T to discharge. A corresponding output pulse is generated at f_{out} (Pin 5) of a defined amplitude, and programmable width determined by the values selected for R_T and C_T (Pin 6). The average voltage of the output pulse train increases with motor speed. When fed through a low pass filter or integrator, a DC voltage proportional to speed is generated. Figure 2 shows the proper connections for a typical closed

loop application using the MC33035 brushless motor controller. Constant speed operation down to 100 RPM is possible with economical three phase four pole motors.

The ϕ_A inverter output (Pin 4) is used in systems where the controller and motor sensor phasing conventions are not compatible. A method of converting from either convention to the other is shown in Figure 3. For a more detailed explanation of this subject, refer to the text above Figure 39 on the MC33035 data sheet.

The output pulse amplitude V_{OH} is constant with temperature and controlled by the supply voltage on V_{CC} (Pin 8). Operation down to 5.5 V is guaranteed over temperature. For systems without a regulated power supply, an internal 8.25 V shunt regulator is provided.

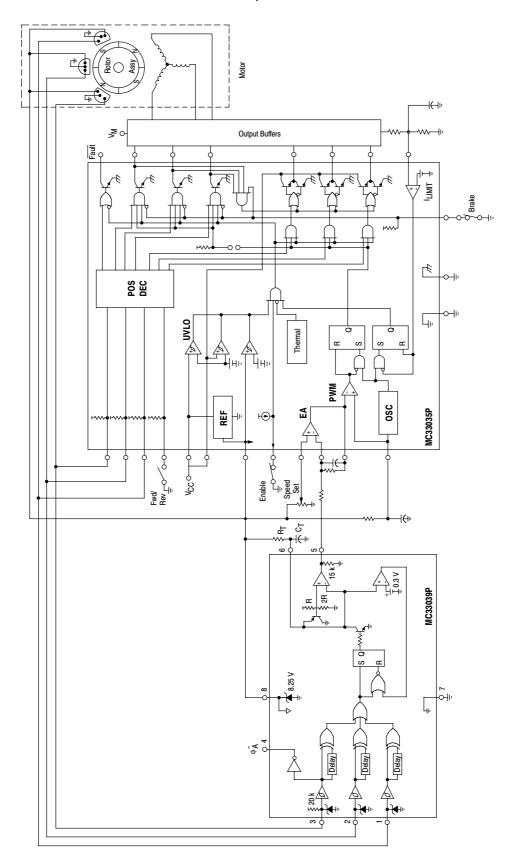


Figure 2. Typical Closed Loop Speed Control Application

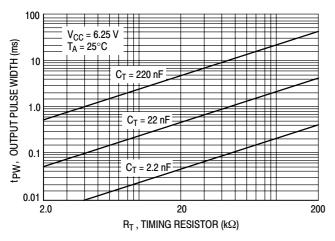


Figure 3. f_{out}, Pulse Width versus Timing Resistor

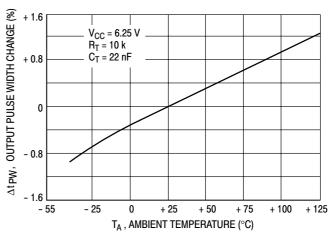


Figure 4. f_{out}, Pulse Width Change versus Temperature

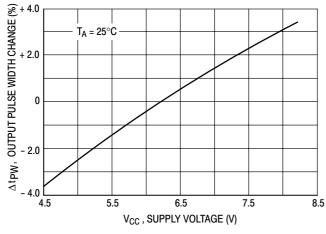


Figure 5. f_{out}, Pulse Width Change versus Supply Voltage

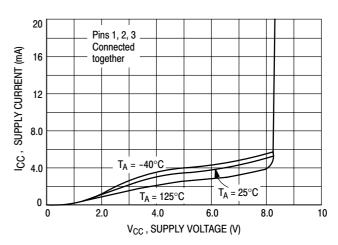


Figure 6. Supply Current versus Supply Voltage

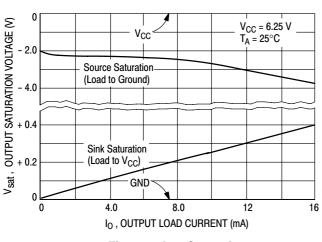


Figure 7. f_{out}, Saturation versus Load Current

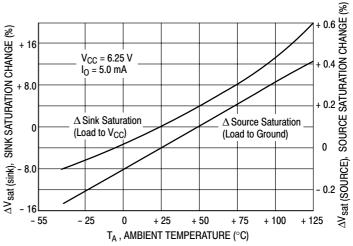


Figure 8. f_{out}, Saturation Change versus Temperature

ORDERING INFORMATION

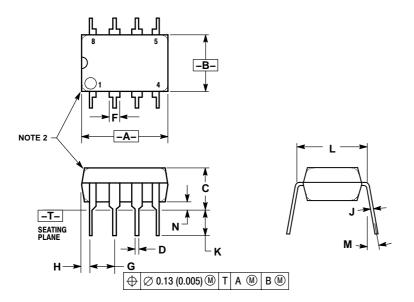
Device	Operating Temperature Range	Package	Shipping [†]		
MC33039D			00 Heite / Deil		
MC33039DG		0010.0	98 Units / Rail		
MC33039DR2	T 4000 / 0500	SOIC-8	2500 / Tape & Reel		
MC33039DR2G	$T_A = -40^{\circ}\text{C to } +85^{\circ}\text{C}$				
MC33039P		PD10 0	50 Units / Rail		
MC33039PG		PDIP-8			
NCV33039DR2*	- 1000 i 1000	2010	2700/7		
NCV33039DR2G*	$T_A = -40^{\circ}\text{C to } +125^{\circ}\text{C}$	SOIC-8	2500 / Tape & Reel		

[†]For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.
*NCV33039: T_{low} = -40C, T_{high} = +125C. Guaranteed by design. NCV prefix is for automotive and other applications requiring site and change control.

PACKAGE DIMENSIONS

P SUFFIX

PLASTIC PACKAGE CASE 626-05 ISSUE L

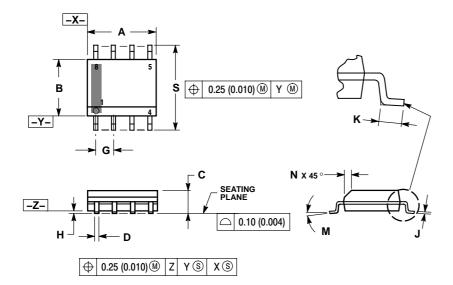


- NOTES:
 1. DIMENSION L TO CENTER OF LEAD WHEN FORMED PARALLEL.
 2. PACKAGE CONTOUR OPTIONAL (ROUND OR SQUARE CORNERS).
 3. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.

	MILLIN	IETERS	INCHES		
DIM	MIN	MAX	MIN	MAX	
Α	9.40	10.16	0.370	0.400	
В	6.10	6.60	0.240	0.260	
С	3.94	4.45	0.155	0.175	
D	0.38	0.51	0.015	0.020	
F	1.02	1.78	0.040	0.070	
G	2.54 BSC		0.100 BSC		
Н	0.76	1.27	0.030	0.050	
J	0.20	0.30	0.008	0.012	
K	2.92	3.43	0.115	0.135	
L	7.62 BSC		0.300 BSC		
M		10°		10°	
N	0.76	1.01	0.030	0.040	

PACKAGE DIMENSIONS

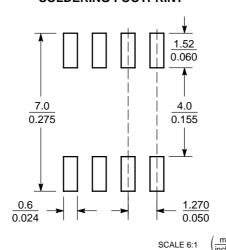
SOIC-8 NB CASE 751-07 **ISSUE AH**



- NOTES:
 1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982. CONTROLLING DIMENSION: MILLIMETER.
- DIMENSION A AND B DO NOT INCLUDE MOLD PROTRUSION.
- MAXIMUM MOLD PROTRUSION 0.15 (0.006) PER SIDE
- DIMENSION D DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.127 (0.005) TOTAL IN EXCESS OF THE D DIMENSION AT MAXIMUM MATERIAL CONDITION.
- 751–01 THRU 751–06 ARE OBSOLETE. NEW STANDARD IS 751–07.

	MILLIN	IETERS	INCHES		
DIM	MIN	MAX	MIN	MAX	
Α	4.80	5.00	0.189	0.197	
В	3.80	4.00	0.150	0.157	
С	1.35	1.75	0.053	0.069	
D	0.33	0.51	0.013	0.020	
G	1.27 BSC		0.050 BSC		
Н	0.10	0.25	0.004	0.010	
J	0.19	0.25	0.007	0.010	
K	0.40	1.27	0.016	0.050	
М	0 °	8 °	0 °	8 °	
N	0.25	0.50	0.010	0.020	
S	5.80	6.20	0.228	0.244	

SOLDERING FOOTPRINT*



*For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

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